DOCUMENT RESUME

ED 406 159 SE 059 820

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TITLE Reform and Reality: A Two Year Study. Observations of Texas Teachers on the Biology I End of Course Examination.
PUB DATE Mar 97
NOTE 19p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Academic Achievement; *Biology; Educational Strategies; High Schools; *Minority Groups; *Science Curriculum; Standards; *Teacher Attitudes; *Testing
IDENTIFIERS Texas

ABSTRACT

The purpose of this study was to explore the perspectives of biology teachers towards the new Texas state-mandated Biology I End of Course Examination. A heuristic inquiry of five biology teachers from two different high schools in one school district was conducted over two years. Audio recordings of interviews, discussions, personal journals, observations and open-ended questionnaires provided the data collection points. The major themes that emerged from the study included teacher confusion about the purpose of the examination, concerns about the validity of the examination, and biology curriculum alteration at the high-minority group high-school. Findings indicate that the examination had the negative effect of lowering the level of skills taught to students in the school with large numbers of minority students. The teachers at the high minority group high school were pressured by administrators to raise their students' examination scores. As a result, the biology curriculum was largely altered to emphasize examination questions, graphing, and measurement. Contains 56 references. (Author/JRH)

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Reform and Reality: A Two Year Study
Observations of Texas Teachers on the Biology I End of Course Examination

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ED 406 159

Abstract

The purpose of this study was to explore the perspectives of biology teachers towards the new Texas state-mandated Biology I End of Course Examination. A heuristic inquiry of five biology teachers from two different high schools in one school district was conducted over two years. The two high schools differed in passing rates on standardized tests required for graduation and in composition of the student body. Audio recordings of interviews, discussions, personal journals, observations and open-ended questionnaires provided data collection points. The analysis of the data was conducted by two independent analysts.

There was agreement between the independent analyses that the major themes which emerged from the study were: 1) teacher confusion about the purpose of the examination, 2) concerns about the validity of the examination, and 3) biology curriculum alteration at the high-minority group high school.

The significance of the study is two fold. First, it is unique in that it documents that educational practices at a high school with large numbers of minority students were especially affected by an end-of-course examination. Secondly, it is unique in that it documents the practice using a heuristic approach through the voices of teachers. It appears from that the examination had the negative effect of lowering the level of skills taught to these students, thereby tending to create separate educational tracks in biology course work according to ethnicity. The teachers at the high-minority group high school were pressured by administrators to raise their students' examination scores. As a result, the biology curriculum was largely altered to emphasize examination questions, graphing and measurement. This type of curriculum alteration is not aligned with reform measures recommended by professional science organizations.

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One-half of the American public does not know the earth goes around the sun once a year and believes that the earliest humans lived at the same time as the dinosaurs (National Science Foundation, 1996, Ch 7, p.8)

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Introduction

The 21st century is upon us and yet many United States citizens lack basic knowledge about scientific concepts described years ago. International science assessments have consistently ranked United States students very low in comparison to other developed countries. The overall evidence indicates a need for improvement in science education in the United States.

Reform measures to improve science education in the United States have been advocated by both educational policy makers and professional science organizations. Educational policy makers such as presidential commissions and state agencies have proposed the creation of national standards and standardized achievement testing for accountability purposes as a means of reforming science education (O'Neil, 1992; Pullin, 1994). Professional science organizations such as the American Association for the Advancement of Science

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[AAAS] and the National Science Teachers Association [NSTA] emphasize conceptual understanding of scientific principles and the solving of real life problems as a means of improving science education. Furthermore, the professional science organizations advocate using "performance-based" assessments such as demonstrations, design and execution of science experiments, open-ended questioning and multiple choice tests in which students must justify their choice (Collins, 1993; Suter, 1992). These two approaches to reforming science education are very different. The traditional, standardized, multiple-choice tests that are advocated by national educational policy makers and state education agencies generally involve word recognition and recall (Morgenstern & Renner, 1984). State-developed, standardized science achievement tests share very similar characteristics. Generally, they are: 1) multiple choice, 2) short (fewer than 60 items), 3) administered for one hour, 4) paper and pencil, 5) made for individual student work and 6) administered no more than twice a year (Gong, Lahart, and Courtney, 1990). These tests have few questions about scientific concepts, and the questions are not organized in clusters that would probe students' understanding of concepts at different levels of difficulty (Gong et al., 1990).

Although it may be the aim of most science teachers to teach for in-depth understanding of science in their students, many teachers when faced with a traditional achievement test feel pressure to teach to the test. The curriculum becomes defined by the test even though the test itself may only test for memorized facts (Madaus, 1988, Mathison, 1991). Thus, science lessons likely lack the hands-on experiments advocated by professional science organizations, if rote memorization is all that is necessary to do well on standardized science achievement tests. Clearly, the instructional philosophy of science educational reform movements such as Project 2061 from AAAS and Scope, Sequence and Coordination (SS&C) from NSTA are not compatible with reform movements that are based solely on standardized achievement testing.

Reform in science education in Texas is being driven by standardized achievement testing as mandated by the Texas Legislature. The End of Course Examination in Biology was first administered to all biology students in the spring of 1994. It is a traditional multiple-choice, machine scorable test of approximately 42 questions (Texas Education Agency [TEA], 1994, Westerlund, 1996). As of June 1996, TEA has not planned to develop performance-based tests for the End of Course Examination in Biology (Bruce Young, TEA Assessment Office, 6/21/96, personal communication). The End of Course Examination in Biology was developed to "provide information about the effectiveness of a school's instructional program" (TEA, 1993). It is part of the Texas Accountability System. In the future, end-of-course examinations will be used as graduation requirements for students (TEA, 1995). Will the students of Texas become more knowledgeable about biology education as schools respond to the evaluations imposed by TEA? In other words, will biology education be reformed in Texas as a result of the End of Course Examination in Biology? The End of Course Examination in Biology is a standardized achievement test of 42 multiple choice items. It is not a performance-based examination nor are any of the exam's questions open-ended. In its present form, the End of Course Examination in Biology does not conform with science education reform measures advocated by professional science organizations. In its present form, it is uncertain whether it will improve biology education in Texas.

The influence of standardized testing on schooling is multifaceted. It is partially determined by whether the test is a "high stakes" test. A "high stakes" test is one in which accountability decisions are based. If results from the test can publicly label a school or if

passing the test is a graduation requirement, it is a "high stakes" test (Madaus, 1991). Therefore, in Texas, the End of Course Examination in Biology is a "high stakes" test. The purpose of "high stakes" tests are generally for accountability and control (Wideen, O'Shea, & Ivany 1992). These tests become powerful "curricular magnets" when implemented into school systems because they can strongly influence the curriculum (Popham, 1987). Basically, the implementation of a "high stakes" test transfers control of the curriculum from the teacher to the agency that designs the test (Madaus, 1991). Since "high stakes" tests are curricular magnets, these state developed science achievement tests support a curriculum wherein the emphasis is on low level thinking and low level knowledge (National Science Foundation, [NSF], 1992). Thus, implementation of these tests including the End of Course Examination in Biology in Texas, tend to encourage a curriculum that is based on a superficial learning of a wide variety of science concepts.

Minority students traditionally have not scored as well as Anglo students on standardized tests. For example the 1994 National Association of Educational Progress [NAEP] science trend assessments showed a difference in average proficiency between African-American and Anglo students of 49 (on a five level proficiency scales, 150, 200, 250, 300, and 350) at age 17 (NAEP, 1996). These differences in achievement have been relatively constant on six prior assessment periods dating back to 1969 (Mullis, 1994). These trends are reflected in standardized tests in Texas. A TEA statewide preliminary report on the December 1994 administration of the Texas Biology I End of Course Examination reported passing rates. Overall, 53% of students (of 11, 828 reported) passed the tests. Eighty percent of Anglo students passed whereas only thirty-nine percent of Hispanic students and thirty-five percent of African-American students passed (TEA, 1994, Summary Report Date 1/95).

Because of the performance of minority students on standardized tests, teachers of minority students often feel the influence of standardized testing in their classrooms more than do teachers of primarily Anglo students (Madaus, 1994). A nationwide survey of 2, 259 science and mathematics teachers indicated that 75% of those with high-minority (above 60%) classrooms felt more pressure from their districts to succeed on standardized tests. This pressure is translated into classroom practice: 75% of teachers of high-minority classrooms report "teaching test-taking skills" versus 42% of teachers of low-minority (less than 10%) classrooms; 64% of teachers of high-minority classrooms report "teaching test-motivating materials" versus 22% of teachers of low-minority classrooms; and 60% of teachers of high-minority classrooms report "teaching topics known to be on the test" versus 19% of teachers of low-minority classrooms (NSF, 1992). These results indicate that minority students in the United States are being taught science in a different manner than are Anglo students, as a result of standardized testing. If preparing for the state science assessment means focusing on low level knowledge and thinking skills (NSF, 1992), then the science program for minority students may be a program of institutional racism that adversely affects the education of all students. The influence of standardized testing for high-minority classrooms may be very damaging to the futures of minority students if it denies them opportunities to develop higher order thinking skills and to be exposed to technology in science (Oaks, 1985). Furthermore, the practice of standardized testing which results in altered instruction for minority students may violate the United States Constitution under the Due Process and Equal Protection Clauses (Pullin, 1994).

There is a need to determine the effects of the Texas Biology I End of Course Examination on biology curriculum and instruction. This need is determined by several factors: 1) no formal study has been conducted on its possible effects, 2) the traditional multiple choice format of the examination conflicts with current science education reform measures, 3) "high-stakes" nature of the Biology I End of Course Examination may create negative consequences for schools, teachers, students, and in particular, high-minority classrooms, and 4) the observations may help to improve the examination.

Purpose

The purpose of this study was to explore the perspectives of biology teachers towards the End of Course Examination in Biology. In particular, it explored the perceptions of biology teachers as to whether a standardized multiple-choice test altered the curriculum and instruction towards rote memorization of facts solely in preparation for the examination, at the expense of more complex development of ability of students to master abstract concepts that are critical to understanding science. This type of alteration would conflict with science education reforms advocated by professional science organizations. Furthermore, the study determined if there was a change in teacher perceptions over time.

Research Question

The overall research question was to explore teacher perceptions about the End of Course Examination in Biology and possible influences the examination may have on the curriculum and instruction of Biology I . Due to the open and flexible nature of the study, new research questions emerged as the study progressed.

Overview of Method

A qualitative study primarily based on interviewing a small sample of biology teachers was used to answer the research question. A qualitative study is most appropriate for a study in which teachers' perspectives are considered (Patton, 1990). To capture how teachers feel about the Biology I End of Course Examination, the study was designed to be open and responsive to their ideas. It had exploratory and flexibility features so that teachers' thoughts were probed to develop an understanding of his or her perspective. Repeated in-depth interviewing of teachers, teachers' spontaneously tape-recorded thoughts into their own tape recorders, and teachers' diagrams of their thoughts generated a deeper understanding of their ideas about the Biology I End of Course Examination. This study was exploratory research on end-of-course testing, a new phenomenon in Texas. The influence of the examination on curriculum and instruction was not well understood.

Research Design

The research design of the study was set in a type of phenomenological qualitative research called heuristic inquiry. Heuristic research is characterized by the discoveries, personal insights, and reflections of the researcher. It is an inquiry into a phenomenon in which both the researcher and the subjects of the research share the same intense personal experiences with the phenomenon being studied (Douglass & Moustakas, 1985; Patton, 1990). It does not assume the detachment of the researcher from the phenomenon being studied. The researcher is very connected to the research. In this study, I was a biology teacher like those who were interviewed and I also have had direct experience with the Biology I End of Course Examination. I examined teacher perspectives on the test both as a researcher and as a biology teacher. Lastly, in heuristic research, the research participants remain visible in the examination of data and continue to be portrayed as whole persons (Patton, 1990).

The research was conducted in a qualitative manner with a heuristic approach. A *purposeful, maximum variation* sample of five Texas biology teachers who taught both before and after the implementation of the Biology I End of Course Examination was used (Patton, 1990). The sample was *purposeful* in that cases were selected that would yield the most information about the research question. It was vital that these teachers had taught before the test so that they could determine whether they had changed their teaching methods in response to the test. The sampling was considered of *maximum variation* because the sites varied considerably in terms of academic performance on standardized tests and student ethnicity. Three biology teachers, including myself, were sampled from Roosevelt (fictitious name) High School and two biology teachers were sampled from Marshall (fictitious name) High School. The five teachers provided data in various ways over a two year interval.

Background of Researcher

I hold a Bachelor's degree in Biology and a Ph.D. in Science Education from The University of Texas at Austin and a Master's degree in Genetics from The University of Minnesota. I have taught the Biology I course for seven years at Roosevelt High School.

I believe that the results of basis skills standardized testing such as the have significantly affected the curriculum at Roosevelt High School. Many activities were added to the curriculum in all classes with improvement in basic skills test scores as the objective. The addition of basic skills activities to the curriculum resulted in other areas of the curriculum being deleted or given less emphasis due to time constraints.

I was interested in observing the influence of the Biology I End of Course Examination on biology instruction from the biology teacher's perspective. In the interview component of the study, I was a participant observer. My beliefs and attitudes from being a biology teacher before and after the implementation of the examination influenced the type and the depth of questions I asked. I brought to the interview process a greater understanding of the complexities involved in teaching the Biology I curriculum. My extension questions were influenced by my own personal experience. In this way, I participated in the research as well as observed.

Site Selection

The setting of the study was Roosevelt and Marshall High Schools. Roosevelt High School was the setting were most of the study was conducted.

Roosevelt High School

The Roosevelt High School setting was ideal for this particular study for the following reasons:

1) There was easy access, since I was there teaching, observing, and conversing with teachers.
2) There were two biology teachers at Roosevelt High School who were willing to participate in the study.
3) I already had long-term, trusting relationships with the biology teachers at Roosevelt High School, and this is essential for a good qualitative study.
4) Power conflicts were not present between me, the teacher-researcher, and the subjects of the research because of our relationship. This increased the credibility of the study, and thereby generated high quality data.

Marshall High School

Marshall High School was selected as a second site for data collection for the following reasons.

1) It was used to enhance the quality of data analysis by serving as a "negative case".

A negative case in qualitative research is defined as "those instances or cases that that do not fit within our understanding of patterns and trends". Qualitative researchers can better understand patterns in their data if they consider situations that do not fit the pattern (Patton, 1990).

2) There was easy access to research subjects. There were two biology teachers willing to participate in the study. I shared a professional relationship with these two teachers prior to the study. My relationship with these two teachers was that of one biology teacher helping a fellow biology teacher.

Differences between Roosevelt and Marshall High Schools

Roosevelt and Marshall High Schools differed considerably in their passing rates on Texas' basic skills standardized test, the Texas Assessment of Academic Skills , [TAAS], and their student profiles. The TEA Report Card for the 1993/94 School Year stated that Marshall High School had 64.9% of its students passing the TAAS whereas Roosevelt High School had only 38.1% of its students passing the TAAS. Also, the TEA Report Card indicated the ethnic membership for the two schools was different. The Marshall High School student population consisted of 5.8% African-American, 21.7% Hispanic and 69.6% Anglo. The Roosevelt High School student population consisted of 43.2% African-American, 30.4% Hispanic and 24.4% Anglo (TEA, 1995). The NSF defined category of high-minority classrooms (above 60%) applied to Roosevelt High School classrooms. The two high schools were very different, each with its own set of problems, challenges and opportunities.

Research Participants

All of the teachers in this study were profiled in detail in teacher portraits in order to gain a better understanding of their approach to teaching biology (Westerlund, 1996). The Roosevelt High School teachers were Lee Tucker, Sandy Meyers, and Laura Langworthy. Sandy and Laura had taught biology for seven to nine years whereas Lee had taught biology for two years. The Marshall teachers were Jordan Spencer who had taught for ten years and Pat Taylor who had taught biology for four years. All names were pseudonyms in order to ensure confidentiality.

Data Collection

Four data sources were used for the collection of data. To validate results, multiple sources of data were used.

1) Interviews and Discussions - The primary data source was personal in-depth interviews, discussions during lunch time or after school and spontaneous conversations over a two year period. All interviews and discussions were audiotaped and later transcribed. There were nine interviews and 14 roundtable discussions / conversations recorded at Roosevelt High School and four interviews and one discussion recorded at Marshall High School. The format of the interviews and discussions were very open-ended so that questions could be directed in whatever direction was appropriate and informative. In heuristic research, these dialogues flow naturally (Moustakas, 1990). Approximately, 160 pages of transcripts of interviews and discussions were gathered from Roosevelt High School; 50 pages of transcripts were gathered from Marshall High School.

2) Oral Journals - The second major data source was oral journals. The teachers at Roosevelt High School were provided with mini-cassette tape recorders. As they went through their daily routines, in the classroom or driving to-and-from school, they recorded any thoughts they had about the Biology I End of Course Examination. All the teachers generally spoke into their recorders as they drove home from work. The data gathered from these oral journals were

valuable because they were totally free of researcher input or bias. There were 40 pages of transcripts from the oral journals. Recorders were not given to the Marshall High School teachers because it was believed this would require so large a time commitment to the study that teacher participation would be discouraged.

3) Open-Concerns Inventory - A third data source was an open-concerns inventory. This inventory was used in order to gather data about the written expression of teachers' perceptions about the examination. A perception is more valid if it is expressed by a teacher both in the oral and written form than if the perception is expressed only once in one data source. The Concerns Inventory was designed for this study was based on concerns inventories from research conducted by James P. Barufaldi at the University of Texas at Austin (James P. Barufaldi, personal communication, 1994). The Concerns Inventory is a modification of the Concerns-Based Adoption Model (CBAM) (Fuller, 1969, Hall, George and Rutherford, 1986). The Concerns Inventory consisted of two questions. On the front of the paper was one question: "When you think about the End of Course Examination in Biology, what are you most concerned about? Place an asterisk (*) next to your most concern". On the back of the paper was the second question asking for diagrammatic expression of their concerns: "Draw a diagram, web, or a map showing what the End of Course Examination in Biology means to you". The Concerns Inventory was administered to the Roosevelt High teachers in December 1994, May 1995, and May 1996. The Concerns Inventory was administered to the Marshall High School teachers in April 1995 and May 1996.

4) Personal Observations - A fourth data source was the tape recording of any events relating to the Biology I End of Course Examination over the normal course of a school day. Observations of teachers and spontaneous discussions with teachers became part of that record. There were approximately 20 pages of transcripts gathered from this data source.

Data Analysis

The transcripts were read several times by myself and the independent analyst. Statements from the transcripts concerning similar ideas or that contained similar key phrases or terms were grouped together under one code. The coding process meant "looking for 'recurring regularities' in the data" (Patton, 1990, p.403). Coded statements were highlighted with a specific code color using the *FolioViews* computer software (Folio Corporation, 1994). In a separate reading and analysis of the data, an independent analyst coded the data with major themes using pen highlighters to specify coded text. It was determined that additional insight about the teachers' perceptions could be obtained from a comparison of two independent coding schemes. Also, the independent analyst was used in analyst triangulation of this study which is a method used to validate a qualitative study.

In this study, triangulation of data sources and analyst triangulation were used to enhance the credibility of the study. Triangulation of data sources occurred when data from the interviews, discussions, oral journals, and concerns inventory questions were compared and contrasted to determine if the teachers expressed the same views in different data sources. Analyst triangulation occurred by way of two separate techniques in the study: 1) Participant teachers from both high schools read the raw transcripts of the interviews, discussions and oral journals. All of the teachers confirmed that the transcription of their remarks was accurate and did not dispute any comment contained within the data. 2) An independent analyst read the raw transcripts and determined if any overall themes were present in the data. The analyst was not aware of the researcher's themes and determined independently the occurrence of any themes in

the data. The independent analyst was a former biology teacher, now a pharmacist, who is certified to teach in Texas, and had taught biology for five years prior to the implementation of the Biology I End of Course Examination. Themes from the researcher and the independent analyst were compared for similarities and differences.

The twelve codes that developed from the transcripts were used to generate six themes. All six of the researcher derived themes were confirmed separately by the independent analyst through analyst triangulation. This confirmation indicates that these themes are present in the data and are not artifacts of researcher bias and prejudices (Westerlund, 1996).

The six major themes concerning biology teachers' views on the Biology I End of Course Examination were *1) purpose, 2) validity, 3) effect on curriculum, 4) effect of students' abilities in passing, 5) effect on teachers and 6) accountability of teachers.* These themes were developed from matrix analysis which enabled the researcher to get a better grasp of the data because it could be seen at a glance rather than embedded in pages of transcripts.

Results

The six main themes developed from the study are reported here in teacher comments representative of each theme in a summary theme matrix (see Tables 1 and 2) accompanied by a discussion of the themes and its relevance to previous work.

Discussion

Overview

The purposes of this study were: 1) to explore the perceptions of biology teachers concerning the Biology I End of Course Examination, 2) to ascertain whether the Biology I End of Course Examination had led to changes in the curriculum and instruction of the Biology I course and 3) to determine whether any such changes conflicted with the objectives of current science education reform measures. The study was open-ended to allow for exploration of ideas related to the examination that were brought up by the teachers.

Purpose of Examination

All of the teachers, except Pat, expressed confusion as to the purpose of the examination. They gave different reasons as to why they thought the test was being given. The confusion that teachers expressed as to the purpose of the Texas Educational Assessment of Minimum Skills [TEAMS] test and the Biology I End of Course Examination was apparent in the (Lutz & Maddirala, 1987) study, the current study, and the pilot studies on the effect of the Biology I End of Course Examination. (Westerlund, 1993, 1994). Other studies (Smith, P.S., Hounshell, Copolo and Wilkerson, 1992; Madaus, 1994; Darling-Hammond & Wise, 1985) did not indicate teachers' confusion as to the purpose of standardized tests.

Table 1
Selected Teacher Comments on the Texas Biology I End of Course Examination
Summary Theme Matrix

PURPOSE	VALIDITY	EFFECT ON CURRICULUM
"Now we give them a test we don't expect them to use for anything. I don't think anybody can think of a good enough reason why the EOC is being done". Sandy 12/94	*'I think the TAAS test is very valid, it is a good indication of whether students have mastered some basic abilities, I can't say the same for the EOC, it was a strange combination of questions and not weighted very well."* Sandy 12/94	*"I think the EOC has caused us not to teach as much as in the regular curriculum. We have spent too much instructional time preparing for tests... 3 or 4 days giving practice tests"*. Sandy 4/4/96
"I wish I had a better understanding of the goals and the purpose of the EOC...if it is information gathering, it might be useful" Jordan, 3/95	*"I don't think it shows a person is knowledgeable in biology. As Sandy said at lunch, a literate 6th grader could pass it. It doesn't demonstrate a knowledge of biology to me.* Laura, 12 7 95	*"An administrator said ' Don't take this as a dictate from me but basically we should throw out the Biology I curriculum and totally focus on those [EOC] objectives'"*. Laura, 3/28/96
"What is the purpose? I really don't know" Lee, 12/7/95 *What does it mean and is it going to be around"?* Jordan, 3/28/96	*"Is this all? Is this the whole thing in 42 questions?"* Lee 12/7/94 *"It is such a short test. If they are going to give an EOC, 42 questions? I think a longer exam if they are going to actually evaluate something."* Sandy, 1/30/95	*"At Roosevelt, they actually special ordered a study skills booklet, specifically for the EOC"*. Laura, 3/28/96 *"This test is not going to change the way I teach"*. Jordan, 3/95
"If it is really just skill based, what is the purpose of the EOC? Laura, 12/17/95	*"I think you need a 100 questions in order for it to be valid when you are covering so much information"*. Sandy, 4/2/96	*"The EOC does not have any bearing on my class. Unless they give me a curriculum to go with that EOC, I am going to use my curriculum"*. Pat, 3/28/96
"I can't get too concerned about it because I don't think it is going to be absolutely mandatory". Pat, 5/95 *"They say we need to teach thematically to keep their attention and whole learning but testing is going back to doing classification and all that'"*. Sandy 2/26/96	*"I had an honor student that scored a 0 on it. They didn't even try. So, how reliable is that? Then I had a student that was repeating my class that scored a perfect score on it"*. Pat 5/95 *"All my honors students could have passed it whether I showed videos or not. It is all prior knowledge"*. Sandy, 3/6/95	*"It is two days less of teaching time. I don't have enough time to teach anyway. Two days. gone"*. Pat, 3/28/96 *"Three days of instruction devoted to going through practice tests, you know what a waste. Since we are on the block schedule, it is almost like two weeks"*. Laura, 12/7/95
"I still don't see the point of it. I think I taught my students better science when I had a full year and we could explore different things like biotechnology". Laura 12/7/95	*"Do it the right way and have a pretest and a posttest, then you can show that learning has occurred"*. Laura 5/95	*" I guarantee that next year my scores will come up, I am going to scrap everything that is not totally related to the test and go strictly with what is exactly on the exam"*. Lee 4/95

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Table 2
Selected Teacher Comments on the Texas Biology End of Course Examination
Summary Theme Matrix

EFFECT ON TEACHER	TEACHER ACCOUNTABILITY	EFFECT OF STUDENT ABILITY ON PASSING
"I certainly do feel more pressure this semester. I wonder how that is going to affect the way I teach. If I am more relaxed, my sense of humor will come through and I can present in more of a relaxed manner". Lee, 12/94	*"You ought to get a handicap if your class is reading at the 40th percentile and is compared to a high school class reading at the 80th percentile".* Sandy, 2/1/94 *"Unless you give a pretest, it can't be for accountability".* Sandy, 12/6/94	*"I bet half of our kids fail because they sit down and say to themselves, 'I don't know anything'. They are self taught. If you could just change that".* Sandy, 1/30/95
"It made me feel uncomfortable. It was a week before I even saw any objectives and I had no idea if I had covered the material they were going to be tested on". Jordan, 3/95	*"Teachers who have students who don't do well on standardized tests may be effective biology teachers but their students' scores may mis-label them as ineffective".* Laura, 6/23/94	*"Sometimes it seems they kinda freeze up on the test. When I go through the thinking process with them, it's like they can get it but [on their own] it's really hard for them to get it and go through that logical thinking process".* Lee, 5/95
"I can't even take it seriously because we are not using it for anything.....we can't even give it because it falls on the day of finals". Pat, 2/28/95 *"I feel like my head is on a chopping block. If my kids don't produce on this exam, there might be some repercussions. That is a stress".* Lee, 12/94	*"Give us the curriculum first, don't give us the test first. Say teach this, then give us the test for accountability".* Pat, 2/28/95 *"Why do they have to break down the scores by teacher? They are going to hold these scores over our heads which we predicted a long time ago".* Lee, 4/4/96	*"Students do so poorly on tests like this because a lot of it is not content, it is just being able to reason. And that is lifelong process which our kids don't have. Maybe it is the confidence to just sit down* [to take test]". Sandy 6/95
"I don't think it bothered anybody. Nobody here got up in arms". Jordan, 3/95 *"Right now I feel more and more pressure. We want out students to do well because it is a reflection on us to some extent".* Sandy, 4/2/96	*"For accountability purposes, I don't think it would be fair to hold someone's feet to the fire that so and so didn't pass. They come with varying skill levels, I can't make up for all that".* Jordan, 3/95	*"Some students will do remarkably well, then some students will miss 20 to 30 questions. I don't know whether it comes from the curriculum or whether it comes from just being able to use your mind to think through things".* Laura, 5/3/95
"The associate principal says, 'I want a listing of the teachers and their percent passing', so there is all this pressure on us that we need to bring these things up". Lee, 1996	*"If this is a tool to pick out who are the bad teachers, I am not sure it is valid because they come to us lacking in so many skills".* Jordan, 3/95	*"I'm sure reading level is going to affect it [EOC scores]. If you are a poor reader, you are not going to be able to understand what the question is asking you. It could be a basic word that could be the crux of the whole question".* Jordan, 3/95
"It [EOC] makes me feel nervous, and I do think about how my students will stand up against other teachers' students". Laura, 12/7/94	*"It is kinda like a competition yet what are you starting with. We are not all starting in an even spot when competing with other schools. I have four new students in one class. Now I am responsible for their scores and I will have had them for one six weeks".* Sandy 4/2/96	*"I have a lot of students who are English as a 2nd language. They should not be penalized for not understanding the language well enough to understand some specific words".* Sandy, 12/95

Validity of Examination

The validity of the Biology I End of Course Examination was questioned by all the teachers, except Jordan. Their perceptions about the validity of the test in measuring biological understanding revealed common themes: 1) brevity of test, 2) inadequate coverage of key biological concepts, 3) lack of clarity of the questions, 4) presence of questions not related to biology, 5) emphasis on skills rather than biology content, 6) lack of a pretest to demonstrate whether learning had occurred, and 7) bias of test toward the dominant cultural group.

That teachers questioned the validity of the Biology I End of Course Examination was consistent with the NSF (1992) study of standardized science achievement tests in interviews with 200 mathematics and science teachers who also doubted the validity of the tests. Since the Biology I End of Course Examination is strictly multiple-choice, the finding that teachers questioned its validity conforms with Yarroch's (1991) research which demonstrated that an open-ended answer format better assesses students' understanding . As an example, Comfort's (1993) study of the California Assessment Program, which examined open-ended questions on a science standardized test, concluded that the program "authentically measures our students' ability to observe, test and draw conclusions." Comfort's study supports the idea that standardized science tests can be valid tools to measure understanding if appropriately designed, as in those that require open-ended answers.

Effect on Curriculum

The Biology I End of Course Examination resulted in changes in the curriculum in all of the five teachers' biology classrooms. The curriculum was changed more at Roosevelt High School than at Marshall High School. Teachers at Roosevelt indicated that the curriculum was altered by: 1) increased emphasis on graphing and measurement skills, 2) reduction in instructional time spent on biological concepts, and 3) lost instructional time due to time spent preparing for the test and time spent administering the test. Teachers at Marshall stated that their biology curriculum was not changed at all by the Biology I End of Course Examination. However, they did mention that the End of Course Examination affected their course by disrupting the students' final examination review and by losing two days of instructional time due to the administration of the examination.

The results of this study are consistent with the P.S. Smith et al. (1992) study on end of course testing in chemistry in North Carolina which found that teachers coped with mandated testing by altering their curriculum to prepare their students for the test. The alteration in the Biology I curriculum towards teaching basic skills such as graphing and measurement and less time on biological concepts is consistent with Stakes' (1991) view that teaching to the test causes students to "gain the most elementary knowledge and skills and less of the deep understanding of topics" It is also consistent with the NSF, (1992) study which indicated that standardized science achievement tests limited the "nature of thinking" . The effect of the Biology I End of Course Examination at Roosevelt High School in Biology I classes was an increased emphasis on low-level thinking skills. This effect was not apparent at Marshall High School.

Effect on Teacher

Teaching practices at Roosevelt High School were changed as a result of the Biology I End of Course Examination. There was no change in teaching practices at Marshall High School as a result of the examination. Changes in teaching practice at Roosevelt included: 1) the presentation of subject matter to the students and 2) the effects of the examination on the teachers. The second change is included since when teachers are affected by an examination,

there will be some alteration in their teaching practices. The effect on teachers at Roosevelt High School was that they tried to present the material at a more rapid pace. There was a "cramming" of the curriculum at Roosevelt. As a result of the Biology I End of Course Examination, teachers at Roosevelt felt: 1) pressure from administrators to raise scores, 2) worried, 3) frustrated, 4) stressed, and 5) nervous and uneasy. The examination's effects on the teachers caused them to alter the Biology I curriculum and the presentation of the curriculum.

Roosevelt High School teachers have been affected by the Texas Biology I End of Examination just as teachers have been affected by the Texas Educational Assessment of Minimum Skills, (TEAMS), and the Texas Assessment of Academic Skills (TAAS) tests (Lutz & Maddirala, 1987; TEA, 1994). These research studies and this study concur that standardized tests cause teachers to feel the need to increase the pace of the course to "cram" in all possible topics that may be included on the examination. The feeling of teachers being pressured by the administration to raise scores was indicated both in this study and in the Lutz & Maddirala (1987) study. Pressure on teachers as an effect of standardized tests was also indicated in the studies of Herman & Golan, 1992; Darling-Hammond & Wise, 1985; P.S. Smith et al. , 1992 ; and Mathison, 1991 which were studies that were conducted outside of Texas. Negative feelings in teachers in this study, such as feeling bad over low passing rates correlated with results from the M.L. Smith study (1989), which stated that teachers often had feelings of shame or embarrassment even when they understood that socioeconomic factors played a significant role in determining student achievement.

The finding that teaching-to-the-test occurred only at Roosevelt High School and not at Marshall High School concurs with the findings of the NSF study, (1992), which found, in a study of 2,259 teachers, that 75% of the teachers who had predominantly (>60%) minority group students, taught to the test. Roosevelt High School had approximately 75% minority group students. Marshall High School had approximately 27% minority group students. (TEA, 1995) State-wide passing rates of 11,828 students on the December 1994 administration of the Biology I End of Course Examination showed significant differences between ethnic groups: 80% of Anglos passed, 35% of African-American students passed and 39% of Hispanic students passed (TEA Summary Report Date 1/95). Roosevelt High School passing rate showed significant differences in passing rates between ethnic groups that were similar to those of the state on the December 1994 administration of the Biology I End of Course Examination: 68% of Anglos passed, 27% of African-Americans passed, and 26% of Hispanic students passed (Biology I Texas End-of-Course Summary Report, January 1995).

The performance differences between minority and Anglo students cause administrators in high-minority districts to pressure those teaching minority students to raise their examination scores. For example, the NSF (1992) study concluded that 75% of teachers in districts with high minority group classrooms felt more pressure from districts to succeed on tests. These NSF results are consistent with the results of this study in which pressure from administration occurred only at the high-minority school, Roosevelt High School. There was no pressure on teachers at Marshall High School to raise examination scores. In fact, there was so little concern at Marshall about the examination, that the school officials decided to make the May 1995 Biology I End of Course Examination optional for their students (Westerlund, 1996).

Effect on Minority Students

These results suggest that minority group students are being taught biology in a different manner than Anglo students in the same district due to the effects of administrative pressures being exerted on teachers of minority students. These results are in agreement with the research of Madaus, (1994) and NSF, (1992), which showed that teachers of minority group students often feel the influence of standardized tests more than teachers of primarily Anglo students. If minority group students are taught in a different manner to prepare them for success on the examination and it means focusing on low level knowledge and thinking skills, then the science program for minority students may be a program of institutional racism that adversely affects their education. At Roosevelt High School, minority group students were taught more graphing and measurement skills at the expense of developing insight into biological concepts such as biotechnology, genetics etc. The influence of the Biology I End of Course Examination on the Biology I curriculum in high-minority group classrooms may damage the futures of minority group students if it denies them opportunities to develop higher order thinking and in-depth understanding of biological concepts.

Teacher Accountability

All of the teachers expressed concern about teacher accountability. They all believed that teachers should not be held accountable for their students' end-of-course examination scores. Their reasons included: 1) many students lack basic skills, 2) poor class attendance, 3) teachers' not knowing what is on the end-of-course-examination and 4) absence of a pretest. Also, several of the teachers indicated that being held accountable was stressful.

The remarks from Texas teachers a decade ago, about the TEAMS test and teacher and school accountability (Lutz & Maddirala, 1987) were very similar to remarks from Roosevelt and Marshall High School teachers about the Biology I End of Course Examination. For example, the observation that "It is grossly unfair to compare classes and schools across the state by using TEAMS scores," (Lutz & Maddirala, 1987) is similar to comments from Sandy about the Biology I End of Course Examination: "There are unbelievable differences between schools. You ought to get a handicap if your class is reading at the 40th percentile compared to a high school in which students are reading at the 80th percentile." Consistently, teachers felt they should not be held accountable for differences between schools in student performance. The practice of accountability measures and its correlation to student selection practices were seen in this study and other research studies. Student-selection, such as not allowing special education students to take tests in order to prevent their scores from being counted in the school report---practices that Darling-Hammond (1994) and Shepard (1991) indicated occurs-- began to occur in the final semester at Roosevelt: "I was making a list of who I thought was special ed in order to ..[exempt them]." (Sandy, 4/2/96) Other practices of student-selection to boost school report scores such as keeping out educationally disadvantaged students or allowing students to drop out were not mentioned in the present study.

Effect of Student Abilities on Passing

All of the teachers except Pat commented on the varying abilities of students and whether those abilities would enable them to pass the Biology I End of Course Examination. Students' proficiencies in 1) reading, 2) the English language, 3) test taking skills and 4) general thinking skills all contribute to whether they pass the examination, according to the teachers in the study. Attitude was also mentioned by two teachers as a factor that affects a student's ability to pass the examination.

"Student abilities which enable students to pass tests" was a strong theme that emerged from teacher comments at both Roosevelt and Marshall High Schools. These teachers acknowledged the fact that skills which students bring to the classroom at the beginning of the semester ultimately determined their performance on a test at the end of the semester. These results are consistent with McLaughlin's (1991) research that addressed language and reading skills in students as key determinants of success on standardized tests and Oberlin's research (1982) which demonstrated that good readers do better than poor readers on standardized science achievement tests. Also, a Dade County Office of Accountability 1992 report stated that differences between schools in performance on tests between schools are mainly due to the characteristics of the students (Dade County Public Schools, Office of Accountability, 1984).

Summary of Discussion

The Biology I End of Course Examination is a "high stakes test" because accountability decisions are based upon it (Texas Education Agency, 1995, Senate Bill One). "High stakes tests" serve as "powerful curricular magnets" in that curricula are altered to conform to the test (Popham, 1987). This study documents that the Biology I curriculum was altered to "teach for the test" at Roosevelt High School. Teachers were pressured at Roosevelt High to raise their scores, as is typical of pressures from administrators at schools with mostly minority group students (NSF, 1992). The curriculum was not altered in order to teach biological concepts in greater depth, as is recommended by professional science organizations such as the National Academy of Sciences, (National Academy Press, 1996), AAAS, (AAAS, 1989) and NSTA (Suter, 1992). The curriculum was altered in a manner that reflected the questions expected on the test. The test had measurement and graphing on it, so the curriculum was altered to emphasize graphing and measurement. This result conforms to Popham's theory (1987) that standardized tests act as powerful curricular magnets. The curriculum alteration at Roosevelt High School was towards teaching low level skills and knowledge. This is consistent with previous studies that demonstrated the effects of "teaching to the test" (Morgenstern & Renner, 1984, NSF, 1992). Curriculum alteration occurred only at Roosevelt High School and not at Marshall High School, in keeping with prior studies which showed this phenomenon typically occurs at schools with predominantly minority group students, as teachers experience pressure from administrators. The altered curriculum for minority students at Roosevelt High School was different from the unaltered curriculum for primarily Anglo students at Marshall High School.

Importance of Study

No previous studies are known that concern the influence of end-of-course testing on teachers and students in Texas. The P.S. Smith et. al (1992) study in North Carolina is the only one that addresses specifically the influence of an end-of-course test on curriculum and instruction. There is a dearth of analyses on end-of-course tests . This study addresses the need for information about the effects of these tests, thereby expanding contributions in this field.

The study was important because it indicated that science education in Texas is not being reformed as a result of the Biology I End of Course Examination. Furthermore, the effects of the Biology I End of Course Examination on the Biology I curriculum and instruction conflict with reform measures advocated by professional science organizations such as AAAS and NSTA.

The study was important because it contributed to the methodology of heuristic research. Heuristic inquiry has not been used to answer questions regarding the influence of standardized

tests on curriculum and instruction. Researchers in this field tend to be university-based and thus, cannot evaluate the data from the perspectives of a high school teacher.

Implications

End of Course Examinations in science courses may not be effective in reforming science education. The present study in Texas on end of course testing in biology and the Smith et al. study (1992) in North Carolina on end of course testing in chemistry both concur that teachers and curriculum are effected by end of course testing. In both studies, teachers reported feelings of being pressured due to the end of course examination. Teachers coped with mandated testing by altering their curriculum to prepare their students for the test. The present study indicates no evidence in 2 1/2 years that the biology curricula at Roosevelt or Marshall High Schools has been reformed in a manner consistent with recommended reform measures from professional science organizations.

Concluding Remarks

The objective of the state of Texas in the development of standardized testing in biology is laudable even though at present the purposes are not entirely clear to teachers and the application of outcomes of testing conceivably may be quite detrimental -- if used in a punitive manner. Furthermore, end-of-course testing in biology in its present format is not consistent with science education reform measures advocated by professional science organizations. The end-of-course testing, might, however, be very valuable in focusing the state's attention on areas in which there is such serious weaknesses in basic skills of students as to impede their ability to learn. The remedy of this problem may require allocation of additional resources to establish classes in the basic skills of language, reading, measurement and graphing skills, etc. Further attention may need to be directed at societal factors that have detrimental effects on students' ability to learn, including commitment of parents and the community to enforcing student attendance in classes and completion of homework.

> *We pass through this world but once. Few tragedies can be more extensive than the stunting of life, few injustices deeper than the denial of an opportunity to strive or even to hope, by a limit imposed from without, but falsely identified as lying within.*
> *(Stephen Jay Gould, The Mismeasure of Man, 1996)*

Bibliography

American Association for the Advancement of Science (AAAS). (1989). Science for All Americans. A Project 2061 Report on Literacy Goals in Science, Mathematics, and Technology. Washington, D.C: American Association for the Advancement of Science.

Collins, A. (1993). Issues in Assessment: Purpose, Alternative Assessment and Equity. School of Education Review (5), 68-77. (ERIC Document Reproduction Service No. ED 370 771

Comfort, K. (1993). New Directions in Science Assessment in California: Moving "Beyond the Bubble". School of Education Review (5), 78-85.
(ERIC Document Reproduction Service No. ED 370 771)

Dade County Public Schools, Office of Accountability. (1984). Subject Area Test Results: Life Science and Algebra I. (Report Evaluative / Feasibility 142). Miami, Florida.

(ERIC Document Reproduction Service No. ED 256 795

Darling-Hammond, L. & Wise, A.E. (1985). Beyond Standardization: State Standards and School Improvement. The Elementary School Journal (85)3, 315-336.

Darling-Hammond, L. (1994), Performance-Based Assessment and Educational Equity. Harvard Educational Review (64)1, 5-30.

Douglass, B.G. & Moustakas, C. (1985). Heuristic Inquiry: The Internal to Know. Journal of Humanistic Psychology (25)3, 39-55.

Folio Corporation. (1994). Folio Views Infobase Manager [Computer Program]. Provo, Utah: Folio Corporation.

Fuller, F.F. (1969). Concerns of Teachers: A developmental conceptualization. American Educational Research Journal, 1969, 6(2), 207-226.

Gong, B., Lahart, C., and Courtney, R. (1990, April). Current State Science Assessments: Is Something Better Than Nothing?. Paper presented at the Annual Meeting of the American Educational Research Association, Boston, MA.

Gould, S. J. (1996). The Mismeasure of Man New York, NY: W.W. Norton & Company

Hall, G.E, George, A.A., & Rutherford, W.A., (1986). Measuring Stages of Concern About the Innovation: A Manual for Use of SoC Questionnaire. Austin, Texas. Southwest Educational Development Laboratory.

Herman, J. and Golan, S. (1992). Effects of Standardized Testing on Teaching and Learning. CSE Technical Report 334. National Center for Research on Evaluation, Standards, and Student Testing, University of California at Los Angeles.

Lieberman, A. (1991, November) Accountability as a Reform Strategy. Phi Delta Kappan, 219-220.

Lutz, F.W. & Maddirala, J.S. (1987). State Mandated Testing in Texas: The Teacher Response. Monograph, No.4 East Texas State University, Center for Policy Studies and Research in Elementary and Secondary Education, Commerce, Texas. (ERIC Document Reproduction Service No. ED 306 084.

McLaughlin, M.W. (1991, November) Test-Based Accountability as a Reform Strategy. Phi Delta Kappan. 248-251.

Madaus, G. F. (1988). The Influence of Testing on the Curriculum", Critical Issues in Curriculum, in L. Tannerm 87th Yearbook of the National Society for the Study of Education, (p 83-121). Chicago: University of Chicago Press.

Madaus, G. F. (1991, November). The Effects of Important Tests on Students *Implications for a National Examination System.* Phi Delta Kappan p. 226-231.

Madaus, G.F. (1994). A Technological and Historical Consideration of Equity Issues Associated with Proposals to Change the Nation's Testing Policy. Harvard Educational Review 64(1). 76-95.

Mathison, S. (1991). Implementing Curricular Change Through State Mandated Testing: Ethical Issues. Journal of Curriculum and Supervision, 6 (3). 201-212.

Morgenstern, C.F., & Renner, J.W. (1984). Measuring Thinking with Standardized Tests. Journal of Research in Science Teaching, 21(6), 639-648.

Moustakas, C. (1990). Heuristic Research Design, Methodology, and Applications. Thousand Oaks, CA: Sage Publications.

Mullis, I, S. (1994). Trends in Academic Progress. Achievement of U.S. Students in Science. 1969 to 1992. (Report No. ISBN-0-16-045132-9) Washington, D.C: National

Center for Education Statistics. (ERIC Document Reproduction ServiceNo. ED 375-172).

National Center for Education Statistics (1996). Report in Brief Trends in Academic Progress. Washington, D.C: Educational Testing Service.

National Academy of Sciences. (1996). National Science Education Standards. Washington, D.C: National Academy Press.

National Science Foundation. (1992). The Influence of Testing on Teaching Math and Science in Grades 4-12 (Report: Center for the Study of Testing, Evaluation and Educational Policy) Chestnut Hill, MA.

National Science Foundation. (1996). Chapter 7: Science and Technology: Public Attitudes and Public Understanding, In National Science Foundation, Science and Engineering Indicators 1996, 3-21. Washington, D.C: U.S. Government Printing Office.

Oaks, J. (1985). Keeping Track: How Schools Structure Inequality. New Haven, Conn: Yale University Press.

Oberlin, L. (1982). What Standardized Achievement Tests Do and Do Not Tell the Teacher of Elementary and Junior High Science-- The Implications for Teacher Education Paper presented at the Annual Meeting of the National Science Teacher's Association. Chicago, Illinois. (ERIC Document Reproduction Service No. ED 219 282)

O'Neil, J. (1992, September). Schools Pushed to Broaden Access, Overhaul Practice. Curriculum Update. (ERIC Document Reproduction Service No. ED 359 031).

Patton, M.Q. (1990). Qualitative Evaluation and Research Methods. (2nd ed.). Newbury Park, CA: Sage Publications.

Popham, J.. (1987, May). The Merits of Measurement-Driven Instruction. Phi Delta Kappan 679-683.

Pullin, D.C. (1994). Learning to Work: The Impact of Curriculum and Assessment Standards on Educational Opportunity. Harvard Educational Review 64(1), 30-54.

Shepard, L.A. (1991, November). Will National Tests Improve Student Learning? Phi Delta Kappan. 232-238

Smith, M.L. (1989). The Role of External Testing in Elementary Schools Los Angeles, CA: UCLA Center for Research on Evaluation, Standards, and Student Testing.

Smith, P.S. (1990). Survey of State Departments of Public Instruction which have mandated end-of-course testing. Unpublished.

Smith, P.S , Hounshell, P.B., Copolo, C., and Wilkerson, S. (1992). The Impact of End-of-Course Testing in Chemistry on Curriculum and Instruction. Science Education, 76 (5), 523-530.

Stake, R.E. (1991, November). The Teacher, Standardized Testing and Prospects of Revolution. Phi Delta Kappan. 243-247.

Suter, L.E. (1992). Indicators of Science & Mathematics Education in 1992. (Report No. NSF-93-95) Washington D.C: National Science Foundation. (ERIC Document Reproduction Service No ED 365 511)

Texas Education Agency. (1993). A Comparison Biology I End-of-Course Examination to Biology I Essential Elements (Report: Division of Curriculum and Instruction) Austin, Tx.

Texas Education Agency. (1993). Statewide Accountability System An Overview of the Accreditation Procedures as Revised by Senate Bill 7. (Report: The Office of Accountability). Austin, Tx.

Texas Education Agency. (1994). Biology I Texas End-of-Course Summary Report All Students Not in Special Education Statewide Preliminary (Report: Jan 1995 Texas Education Agency)

Texas Education Agency. (1994). The Impact of Educational Reform on Students At Risk in Texas. Final Report of A Study. (Report TEA-GE4-170-11) Austin, Tx: Texas Education Agency. (ERIC Document Reproduction Service No. ED 385 895)

Texas Education Agency. (1994). Biology I Texas End-of-Course Summary Report All Students Not in Special Education (Report: June 1995 Texas Educatien Agency) Austin, Tx.

Texas Education Agency. (1994). Biology I Objectives and Measurement Specifications (Report: Division of Student Assessment). Austin, Tx.

Texas Education Agency. (1994) Texas Education Agency Academic Excellence Indicator System 1992-93 Campus Profile. (Report: Division of Performance Reporting, Office of Policy Planning and Information Management) Austin, Tx.: Texas Education Agency.

Texas Education Agency. (1985). Biology I End-of-Course Summary Report Report Date: Jan 1995, Date of Testing: December 1994. Austin, Texas: Texas Education Agency

Texas Education Agency. (1995). Texas Education Agency Academic Excellence Indicator System 1993-94 Campus Profile. (Report: Division of Performance Reporting, Office of Policy Planning and Information Management) Austin, Tx.: Texas Education Agency.

Texas Education Agency. (1995). Briefing Book on Senate Bill 1 74th Texas Legislature (Report Texas Education Agency) Austin, Tx.

Texas Education Agency. (1995). State of Texas 1994-95 Report Card (Report: Division of Performance Reporting) Austin, Tx.: Texas Education Agency.

Texas Education Agency. (1986). Biology I End-of-Course Summary Report Report Date Winter:1986, Date of Testing: Fall 1995. Austin, Texas: Texas Education Agency

Westerlund, J.F. (1993). [Survey: End of Course Testing in Biology]. Unpublished raw data.

Westerlund, J.F. (1994). [Four Interviews of Biology I Teachers]. Unpublished raw data.

Westerlund, J.F. (1996). Reform and Reality: A Two Year Study Observations of Texas Teachers on the Biology I End of Course Examination. Unpublished doctoral dissertation. University of Texas at Austin, Texas.

Wideen, M.F. , O'Shea, T. and Ivany, G. (1992). External Examinations and the Curriculum: Do they Monitor or Control? Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA. (ERIC Document Reproduction Service No. ED 347 188)

Yarroch, W.L. (1991). The Implications of Content Versus Item Validity on Science Tests Journal of Research in Science Teaching (28)7, 619-629.